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SANDERS, BIG PINE, AND ACWORTH RESERVOIRS STUDY SANDERS, BIG PINE, AND COLLIER CREEKS, TEXAS

Public Health Service
Dallas, Texas

November 1960

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SANDERS, BIG PINE, AND ACWORTH RESERVOIRS STUDY

SANDERS, BIG PINE, AND COLLIER CREEKS

TEXAS

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District - Tulsa, Oklahoma

NOVEMBER 1960

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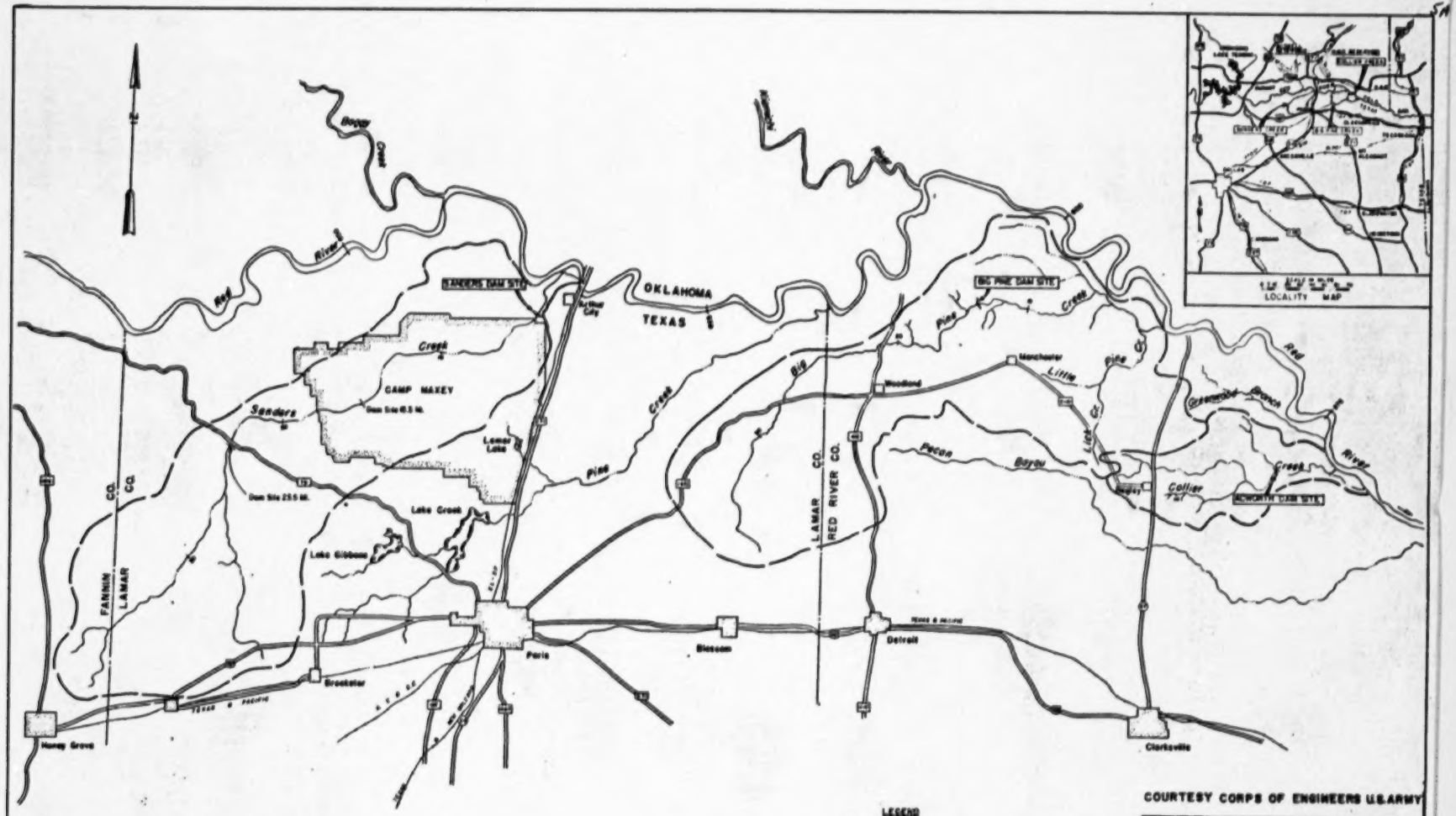

COURTESY CORPS OF ENGINEERS U.S.ARMY

SANDERS, BIG PINE & ACWORTH RESERVOIRS

WATERSHED MAP

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE 1

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INTRODUCTION

General

The District Engineer of the Tulsa District, U. S. Army Corps of Engineers in a letter dated October 2, 1959, requested the Dallas Office of the U. S. Public Health Service to conduct such investigations as required to determine the present and prospective water supply needs which could be met by reservoirs on Sanders and Big Pine Creeks, the quality of water on the respective streams, and the economic value of water supply storage. In addition to the above mentioned sites, it was requested that a preliminary survey of the Acworth Dam site on Collier Creek be undertaken.

The study of municipal and industrial water supply is undertaken in accordance with the Memorandum of Agreement, dated November 4, 1958, between the Department of the Army and the Department of Health, Education, and Welfare and authorized under the Water Supply Act of 1958, Title III of Public Law 85-500.

Acknowledgments

Information and data utilized in this report were obtained from many sources. The cooperation and assistance of the following, either through personal contact or publications, is gratefully acknowledged:

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Industrial Development Department, Texas Power and Light Company

Wisenbaker, Fix, and Associates, Consulting Engineers, Tyler, Texas

Bureau of Business Research, University of Texas

Chamber of Commerce, Bonham, Texas

Chamber of Commerce, Clarksville, Texas

Chamber of Commerce, Paris, Texas

City of Clarksville, Texas

City of Bonham, Texas

City of Paris, Texas

Texas State Department of Health

SUMMARY AND CONCLUSIONS

1. The projects considered in this report are located as follows:

   Sanders - Sanders Creek north of Paris, Texas

   Big Pine- Big Pine Creek northwest of Clarksville, Texas

   Acworth - Collier Creek northeast of Clarksville, Texas

2. The water in Big Pine and Sanders Creeks is acceptable for municipal and industrial use with the exception of a high iron and manganese concentration, which can be removed by treatment. In addition, softening appears to be desirable for Sanders Creek water. No data are available on water quality in Collier Creek.

3. Present water demands of Bonham and Clarksville are supplied from ground water. Paris utilizes a surface water supply. Clarksville and Bonham plan to utilize surface water in developing new sources of supply.

4. Bonham (1960 population 7,508) and Clarksville (1960 population 3,811) are expected to maintain a rate of growth similar to that experienced in the past. It is anticipated that Paris (1960 population 20,696) will grow at a rapid rate through 1970 due to direct and indirect effects of the proposed location of a large food processor in that city. It is predicted that the rate of growth will decrease slightly after 1970. The estimated populations in 2010 are 20,000 for Bonham, 6,000 for Clarksville, and 97,000 for Paris.

5. Water demands for the three cities in 2010 are estimated at 3 mgd for Bonham, .75 mgd for Clarksville, and 33 mgd for Paris.

6. To meet these demands, Bonham has begun the initial stages of developing a single-purpose water supply project on Timber Creek which can supply their needs through 2010. It does not appear that Bonham has a need for storage in the Corps of Engineers projects.

7. The projected demand for Clarksville can be met from present sources of ground water; however, the city desires to develop a surface water supply. The city of Clarksville has passed a resolution requesting the inclusion of storage to yield 26 mgd in the Big Pine Project and indicating its intent to pay for such storage. However, sufficient water appears to be available from the already contracted for Langford Creek Project to supply Clarksville's demands from a surface water source. There is no economic value attributable to storage in the Corps of Engineers Big Pine Project for municipal and industrial water supply.

8. The demand for Paris requires a source of approximately 25 mgd yield in addition to the present source of supply. The city has furnished the Corps of Engineers a resolution indicating its intent to purchase the entire 55 mgd yield of the Sanders Creek Project. The average annual value of storage capable of yielding 55 mgd in the Sanders Creek Project is $222,000, the cost of a single-purpose water supply structure at the same site.

9. There does not appear to be any demand for water supply storage in the Acworth Project. This site should be investigated only if Clarksville desires to purchase storage in it for municipal and industrial water supply.

10. The value of water supply storage in the several projects is as follows:

Project and Expected Demand-2010	Average Annual Value of Storage
Sanders Creek (55 mgd)	$222,000
Big Pine Creek	) No projected demand) on these projects;) therefore, no economic) value is attributable) to water supply storage.
Acworth	

11. There does not appear to be a pollution problem associated with the discharge of Clarksville's wastes into the Sulphur River. It is anticipated that pollution problems will be encountered in Pine Creek due to the discharge of wastes in the Paris area, with a possibility of problems in the Red River. However, this pollution would not affect the quality of water in the projects under consideration in this study. Further study of pollution problems will be undertaken in conjunction with a comprehensive study of southeastern Oklahoma and adjacent areas.

DESCRIPTION OF AREA

The area involved in this study consists of Fannin, Lamar, and Red River Counties in northeastern Texas (See Watershed Map, Figure 1.)

The economy of the area is based principally on agriculture. The soil, primarily black lands, is especially suitable for farming. The principal crops are cotton, corn, rye, and peanuts. There is also a considerable amount of truck farming in the area and cattle, sheep, chicken and turkey raising play an important part in the area's economy. It has been stated that Lamar County, in which both Sanders and Big Pine are located, is one of the best balanced and diversified agricultural economies in the State. [11,12]

The average annual rainfall is approximately 43 inches per year with a mean temperature of about 64°F.

The largest city in the study area is Paris with a 1960 Census population of 20,696. Next in size is Bonham, with a population of 7,508 in 1960, and then Clarksville, 1960 population 3,811. [3]

Industry has not played an important role in the past although there are some lumber operations, manufacturing activities, and agricultural processing. It appears that industry will play a larger role in any future development of the area.

DESCRIPTION OF CORPS OF ENGINEERS PROPOSED PROJECTS

The Sanders Creek Project is located on Sanders Creek approximately thirteen miles north of Paris, Texas. Sanders Creek rises in Fannin County approximately three miles northeast of Honey Grove, Texas. It flows in a northeasterly direction for about fifteen miles and then turns eastward joining the Red River at River Mile 632. The proposed storage for water supply purposes is 99,700 acre feet with an estimated yield of 55 mgd. Pertinent physical data are presented in Table 1.

The Big Pine Project is located at River Mile 13.2 on Big Pine Creek, which rises in Lamar County, approximately five miles north of Blossom, Texas. Big Pine Creek flows north until it reaches the Red River County line, from which point it flows east to its confluence with the Red River at River Mile 585. The proposed Big Pine Project impoundment for water supply purposes is 79,300 acre feet with an estimated yield of 26 mgd. Pertinent physical data are presented in Table 1.

The Acworth dam site is located at River Mile 3.9 on Collier Creek, approximately twelve miles northeast of Clarksville, Texas. Collier Creek rises in Red River County near Negley, Texas, and flows generally eastward to the Red River. The estimated water supply yield from this reservoir is 2.5 mgd with a conservation storage of 2,100 acre feet. Pertinent physical data for the Acworth Project are presented in Table 1.

Table 1

Preliminary Pertinent Data for Proposed Corps of Engineers Projects on Sanders, Big Pine, and Collier Creeks*

Feature	Reservoir		
	Sanders	Big Pine	Acworth
Location:			
Stream	Sanders Creek	Big Pine Creek	Collier Creek
River Mile	4.4	13.2	3.9
Purpose:	F. C. & C.	F. C. & C.	F. C. & C.
Drainage area, sq. mi.	175	95	26
Elevations, ft., m.s.l.			
Top of pool, Flood Control	462.0	430.0	392.0
Top of pool, Conservation	448.0	420.0	376.0
Reservoir area, acres:			
Top of pool, Flood Control	7,950	6,400	1,520
Top of pool, Conservation	5,450	4,640	440
Reservoir storage, ac-ft			
Flood Control	93,600	54,700	13,700
Conservation (W.S.)	99,700	79,300	2,100
Sediment	7,500	4,600	1,600
Total	200,800	138,600	17,400
Water supply yield, mgd	55	26	2.5

*Source: Corps of Engineers, Tulsa District Office

WATER QUALITY IN PROJECT STREAMS

This section presents available quality data as an indication of the water quality to be anticipated from an impoundment on the project streams. Water characteristics which may require special treatment in addition to normal surface water treatment are also discussed.

Sanders Creek

The chemical analyses presented below are averages of samples taken during a portion of one year and, while they may not be entirely representative of the over-all water quality obtained from a large impoundment, they are the best available data.

Table 2

Chemical Characteristics - Sanders Creek [15]
(All units ppm unless otherwise specified)

	Average	Maximum	Minimum
Calcium	73	150	31
Magnesium	14.8	31	6
Iron	1.6	2.6	0.6
Manganese	2.4	4	0.6
Sodium	36	49	16
Carbonate (CO_3)	0	Trace	0
Bicarbonate (HCO_3)	242.6	468	73
Sulfate (SO_4)	46	110	5
Chlorides	52.7	120	17
Fluoride	0.36	0.4	0.3
Nitrate (NO_4)	less than 0.4		
Specific Conductance micromhos/cm.[3]	706.2	1,260	400
Total Alkalinity as $CaCO_3$	233.8	384	165
Hardness	237.5	505	133
pH	7.15	7.3	7.0
Total Solids	385	756	230

Based upon these analyses, the water in Sanders Creek does not appear to be of exceptionally good quality. It is extremely high (4.0 ppm) in iron and manganese, the Public Health Service Drinking Water Standards accepted limit being 0.3 ppm for iron and manganese combined; [19] however, iron and manganese can be removed with suitable treatment. The average hardness of 237.5 ppm is high for most uses and it appears that softening will be desirable.

Big Pine Creek

The following table presents the results of the two chemical analyses of the water in Big Pine Creek.

Table 3

Chemical Characteristics - Big Pine Creek [15]
(All units ppm unless otherwise specified)

Calcium	26.5
Magnesium	5
Iron	2.0
Manganese	0.6
Carbonate	0
Bicarbonate	100
Sulfate	11.5
Chlorides	7
Fluoride	0.35
Nitrates	less than 0.4
Specific Conductance micromhos/cm.[3]	205
Total Solids	153
Total Alkalinity	82
Hardness	88
pH	6.7

The results of the two samples taken from Big Pine Creek indicate that the water is of suitable quality for most domestic and industrial use with the exception of a high iron and manganese concentration. The observed concentration of 2.6 ppm for iron plus manganese greatly exceeds the Public Health Service's recommended limit of 0.3 ppm so treatment for iron and manganese removal should be practiced in addition to normal surface water treatment.

Collier Creek

No quality data are available for the water in Collier Creek at this time. Should this data prove to be necessary, field investigations must be conducted to make the determinations.

ECONOMIC OUTLOOK

The purpose of this section is to define the present and the potential economy of the Sanders - Big Pine - Acworth area.

The 1960 population for the three counties is 73,352. The combined population shows a steady downward trend since 1920. Table 4 presents the county trends.

Table 4

Population for Fannin, Lamar, and Red River Counties 3/
1900 - 1960

	1900	1910	1920	1930	1940	1950	1960
Fannin	51,793	44,801	48,186	41,163	41,064	31,253	23,735
Lamar	48,627	46,544	55,742	48,529	50,425	43,033	33,973
Red River	29,893	28,564	35,829	30,923	29,769	21,851	15,644
TOTALS	130,313	119,909	139,757	120,615	121,258	96,137	73,352

Contrary to the downward trend in the county totals, the major cities have shown an increase since 1930. The city with the most significant growth is Paris. Paris, located in Lamar County, showed a slight loss from 1950 to 1960; however, Paris has demonstrated appreciable growth in the past and exhibits greater growth possibilities for the future. Bonham and Clarksville, which are the second and third largest cities respectively, have also shown increases since 1930. Population figures for the three cities are shown in Table 5.

Table 5

Population for Cities of Bonham, Paris, and Clarksville 3/
1910 - 1960

	1910	1920	1930	1940	1950	1960
Bonham	4,844	6,008	5,655	6,349	7,049	7,508
Clarksville	2,065	3,386	2,952	4,095	4,353	3,811
Paris	11,269	15,040	15,649	18,678	21,643	20,696

The greatest decrease in population has been caused by a decrease in agricultural employment. Increased farm mechanization has had a significant influence in replacing farm labor and has resulted in a decrease in farm population. Table 6 shows the trends in rural population in the past.

Table 6

Population for Rural Areas in Fannin, 3/
Lamar, and Red River Counties
1920 - 1950

	1920	1930	1940	1950
Fannin	33,696	28,591	27,191	17,193
Lamar	38,912	31,411	30,102	19,902
Red River	32,443	27,545	22,852	15,023

Agriculture

The rural population has had a significant decrease since 1920. The greatest decrease was from 1940 to 1950. As has taken place in the past, increased technical advancements will probably result in an additional decrease in farm population over the next 25 years.

Not only has a decrease in farm population occurred, but the number of farms and total cropland harvested have also decreased. However, there has been an increase in livestock and livestock production. The number of cattle and calves has increased over 40 per cent from 1950 to 1954; the milk production has more than doubled during that time for the area. 12/

Minerals Resources and Forest Products

There are few mineral resources of commercial value in the study area. The area has deposits of limestone, gravel, sand, burning clay, and miscellaneous stone. 21/ This would indicate insignificant growth potential for basic mineral industries in the study area. However, some of the surrounding counties, Grayson, Titus, and Franklin Counties produced over $46,000,000 of minerals in 1958. 4/ It is possible that some processing of minerals from surrounding areas may occur in the study area.

There is a considerable amount of timber which supports a number of wood-products industries. A high rate of depletion in the past caused great concern throughout the State and resulted in the

introduction of rigid conservation techniques which limit annual production to its present level. Therefore, no growth in this field is expected at the present time. With reforestation now being put into affect, possibilities of employment growth in the future appear likely. 21/

Industry

Manufacturing industry will be the major influence on the rate of growth of the area's population in the future. There are many factors which influence industrial development in a region, such as raw materials, markets, industrial power, transportation, and building sites.

Mineral and forest raw materials available in this area for future development are insignificant and offer no attraction to new industrial operations. Agricultural products are abundant, indicating a possible increase in the food and kindred products industries.

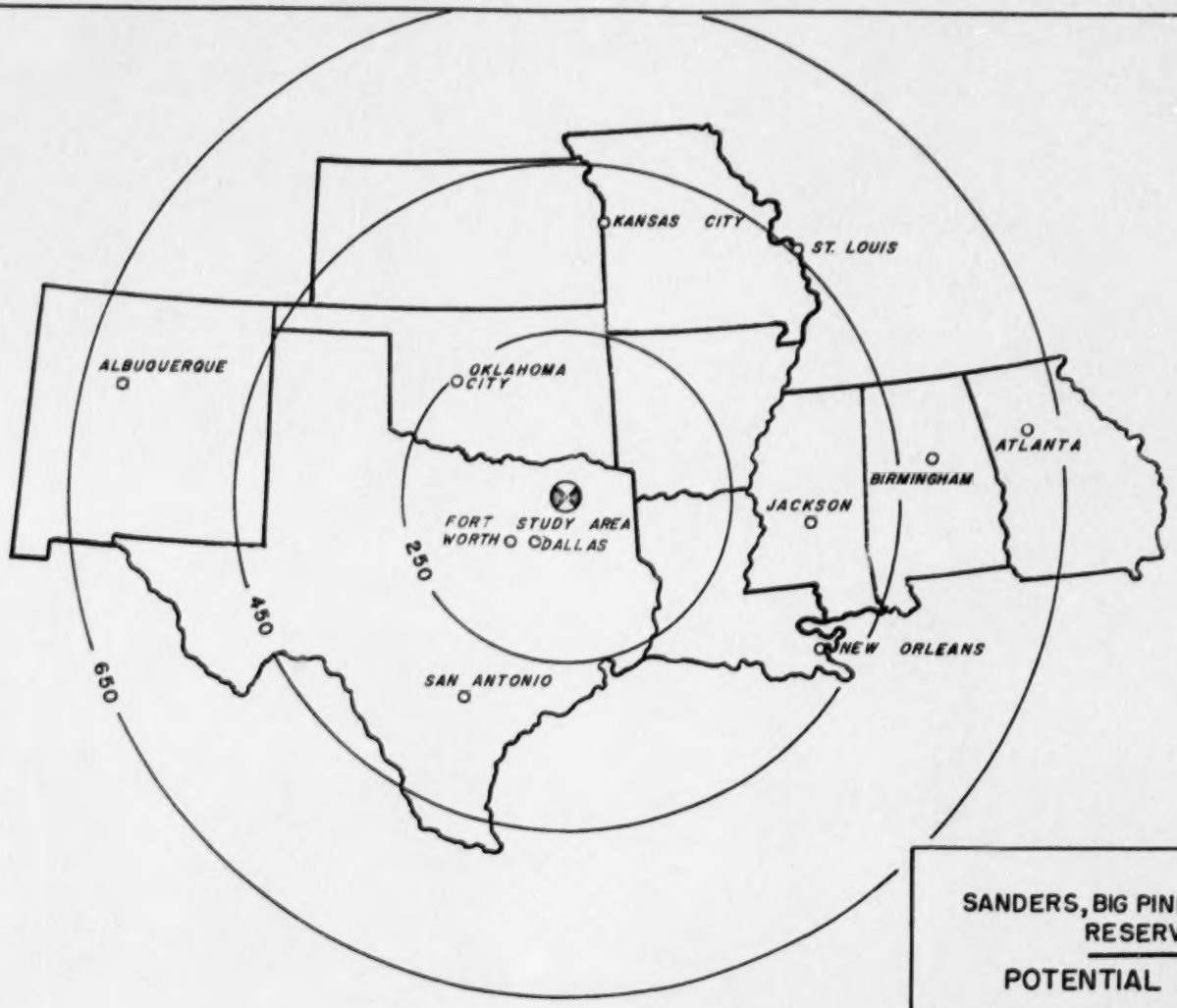
The Sanders - Big Pine area is favorably located for markets in the Southwest. The geographic location makes large metropolitan areas in nine states readily accessible from the Big Pine - Sanders area. The map on the following page shows the distances to these market areas.

North Texas has access to low-cost electric power for industrial development. Natural gas reserves appear adequate to care for industrial expansion for the next fifty years. Supplies of lignite are available as a supplementary fuel source if needed. 21/

This area has good highways and railroad facilities. Trucking may be the most important mode of transportation for this area. With excellent highways, trucks allow flexibility, speed, and low-cost advantages. Truck transportation will help transport an increasing variety of products to and from this area. Railroads, still the leading carrier in the United States, offer economical and dependable service to and from all parts of the United States. The Texas and Pacific Railway Company serves the area.

There are excellent industrial sites available at relatively low cost, close to highways and railroad facilities.

It does not appear that any significant growth will occur in the area outside of the three largest cities. The rural area population, which has been declining, should continue to decrease in the immediate future, after which it should level off; it may even increase slightly near the year 2010 since the area is excellent for agriculture; and, as the Nation grows, there will be a larger demand for food; this should bring about the reversal of the rural trend. 21/



SANDERS, BIG PINE & ACWORTH RESERVOIRS

POTENTIAL MARKETS

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

HJS

FIGURE 2

12A

Clarksville

Clarksville, the smallest of the three principal cities, reveals signs of modest increase. Clarksville has an adequate number of industrial sites, good transportation connections, and a good labor supply; but there are no definite signs of industrialization. The last industrial plant to locate in the city was in 1954. This plant manufactures doors for trailers and has between thirty-five and forty-five employees. In the meantime, Clarksville has lost at least one other prospective firm. 14/ The competition is keen for industrial prospects, and since Clarksville has no outstanding competitive advantages over other communities in this part of the United States, it does not appear that it will experience dynamic growth. By the year 2010 the population should be 6,000.

Bonham

Bonham, located about 36 miles west of Paris, Texas, has had an impressive industrial growth during the past decade. Eight new firms have established there in the past ten years. Three of these firms employ from 190 to 400 workers each. The Bonham Industrial Foundation stands ready to assist firms interested in locating in Bonham.

Recently Bonham has taken steps to attract more industry by hiring consulting engineers to make a water supply development survey. 13/

Bonham has an adequate labor supply, both skilled and semi-skilled. The transportation facilities are good; the railroad and truck service is scheduled to all parts of the United States. There are also good building sites, as well as satisfactory fuel and power.

The steady population growth is attributable to industrial expansion. Assuming this expansion will continue, the population is expected to reach 20,000 by 2010.

Paris

Paris, the largest of the three cities under consideration, has been increasing steadily in population and should continue to do so at a rate greater than that experienced in the past.

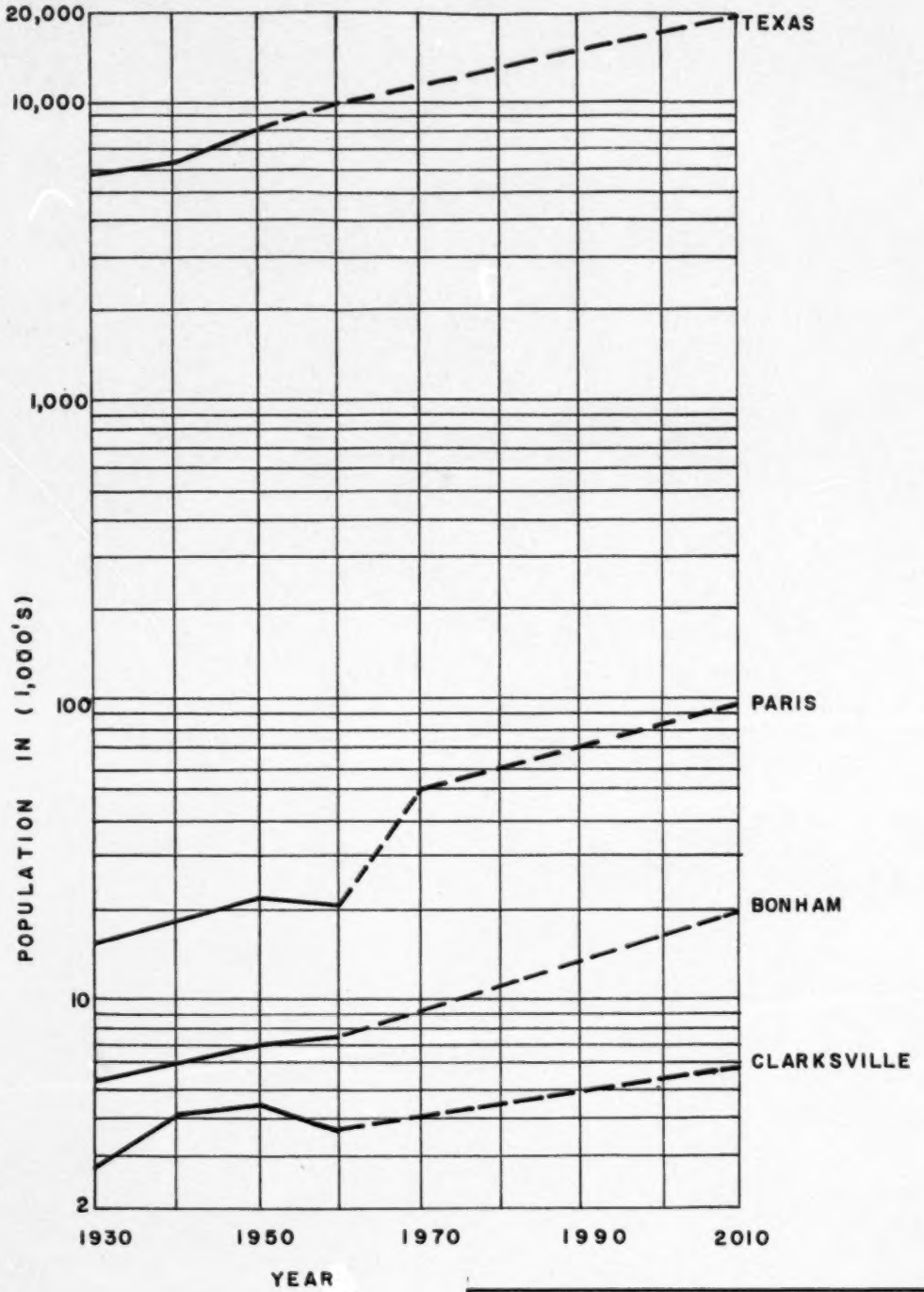
In 1954, there were thirty-six manufacturing establishments located in Paris, four of which employed over 100. 2/ At the present time there are forty-six such establishments, six of which employ

over 100. [17] The area is well suited to a continued growth in the apparel and food processing industries.

The city possesses excellent transportation facilities with four rail lines, five main highways, and commercial air service. There is adequate power in the area. An independent agency has developed land for an industrial park, thereby providing good industrial sites for new industries. In addition, Paris lies in an excellent agricultural area providing abundant livestock and truck crops for the food processing industry.

The Campbell Soup Company has recently purchased over 500 acres in the Paris area to utilize the truck crops produced in the area. Originally, the plant was to employ some 1,200 people, but the latest information indicates that this figure has been increased to between 2,500 and 3,000. [16,17]

In addition to the direct effects of Campbell Soup, there are several indirect effects which will tend to further add to the population growth. It is anticipated that several smaller food processing operations will spring up in the area to handle agricultural products produced in excess of Campbell's requirements. The growth of the food processing industry should also provide an impetus to the development of secondary manufacturing operations, such as jars, cans, food preservatives and other material and equipment for the processing industry. A population increase of 17,000 is projected for the period 1960-1965 due to direct and indirect effects of growth in the food processing industry. The city will experience a very rapid growth from the period 1961 to 1970, probably reaching a population of 60,000. It appears probable that the rate of growth will then tend to decrease, with the population reaching 97,000 by 2010.



SANDERS, BIG PINE & ACWORTH RESERVOIRS

POPULATION TRENDS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

HJS

FIGURE 3

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

Bonham

The town of Bonham obtains its municipal water from three wells drilled approximately 1,200 feet into the Woodbine sand formation underlying the area. The static water level is approximately 300 feet. The maximum dependable draft is approximately 1.5 mgd. The quality is good for domestic purposes but only fair for industrial use because of a high bicarbonate content. 9/

Present use from the municipal system averages 0.8 mgd with peak demands of 1.0 mgd during the summer months. Per capita consumption averages 100 gpd. These figures include all industrial use, as there are no self-supplied industries. 6,9/

The estimated 2010 demand is 2.8 mgd based upon population and industry forecasts developed in the previous section and a per capita use of 140 gpd. The present water supply source is inadequate to meet these demands.

The city is presently in the preliminary stages of developing a source of water supply on Timber Creek north of Bonham. The reservoir will have a drainage area of 29.56 square miles and a capacity of 11,165 acre feet, with a pool elevation of 565.0 feet, msl. The dependable yield is estimated at 7 mgd which is more than sufficient to meet Bonham's estimated needs through 2010. 9/ It does not appear that the city of Bonham will require storage for water supply purposes in any of the Corps of Engineers projects.

Clarksville

Water use from the municipal system in Clarksville is presently 0.4 mgd or 81 gpcd. This water is supplied from four wells having a maximum dependable draft of 2.0 mgd. The water is of good quality; however, the town does not feel the supply dependable enough, or of good enough quality, to be an attraction to industry; and, therefore, desires to develop a surface water supply to meet future needs as well as to replace the present ground water supply. In addition, the aquifer providing the present source of supply is reported to be relatively small and crescent shaped, surrounded by a formation yielding saline water. This situation caused some concern that total dissolved solids in the present source of supply may increase to a concentration which would render it useless as a source of water supply for municipal and industrial purposes.

Projections of water use indicate a demand of 750,000 gpd by the year 2010, based upon a per capita use of 125 gpd and a population of 6,000. The city has agreed to take 1.0 mgd from a Soil Conservation Service dam located adjacent to the town on Langford Creek.

Assuming that the city retains its present wells in operating condition for use as a source to meet peak demands and that the 1.0 mgd Langford Creek Project is used as the major source of supply, it appears that Clarksville will have adequate water to meet municipal and industrial needs through 2010.

City officials contacted have expressed an intention to purchase the entire output of 26 mgd from the Big Pine Project for municipal and industrial water supply and have furnished the Corps of Engineers with a resolution to that effect. However, it is the opinion of this office that they will not have need for this amount of water in the 50-year future.

Value of Storage in Big Pine Project

There is no demand evident at the present time for water supply storage in the Big Pine Reservoir. Therefore, no economic value is attributable to storage in this project for municipal and industrial water supply.

Paris

Paris, Texas, presently obtains its water from Lakes Crook and Gibbons. Both lakes are on the same watershed and have a combined yield of approximately 9.5 mgd. The water is of good quality and suitable for most purposes.

The average water use supplied from the municipal system in 1959 was 2.40 mgd or 98.5 gallons per capita per day. The table below presents water use data from 1925 to the present and indicates an increasing water use from 1925 to 1955. Average daily use decreased from 2.79 mgd in 1956 to 2.40 in 1959. During the same period, per capita use decreased from 120.8 gpd to 98.5 gpd. It is assumed that this trend, presumably reflecting the abnormally high uses during the 1955-56 drought, is transitory in nature and that the average water demands will resume the long-range, upward trend in the future.

Table 7

Historical Water Use Data - Paris, Texas [5,15]

Year	Average Use mgd	Per Capita Use gpd
1925	0.95	63.4
1930	0.96	61.1
1935	0.95	55.6
1940	1.23	69.3
1945	1.89	93.6
1950	1.91	106.5
1955	2.56	109.9
1956	2.79	120.8
1957	2.44	101.2
1958	2.49	101.1
1959	2.40	98.5

It is expected that per capita use will increase in the future due to normal increases in water using devices and increased industrial development, leveling off at approximately 150 gpcd exclusive of use by food processing industries. The following are the projected per capita demands for various years throughout the study period.

Table 8

Estimated Per Capita Water Use for Paris, Texas
1960 - 2010

Year	gpcd
1960	100
1970	125
1980	140
1990	145
2010	150

Based upon the population growth indicated in the previous section and the per capita consumptions, the projected water demands are:

Table 9

Estimated Demand (Exclusive of Food Processing)

Year	mgd
1960	2.7
1970	7.5
1980	10.2
1990	12.3
2010	14.6

In addition to the demands presented above, it is anticipated that a large demand will be developed by the expected influx of food processing industries into the area. The Campbell Soup Company will require 2.0 mgd initially with an ultimate demand of 8.0 mgd expected to develop by 1965. 16,17/ Smaller food processors anticipated to locate in the area should create an additional demand of approximately 10 mgd. Total water use by the food processing industry will reach 18 mgd by the year 1970.

Total water demands for the Paris area for all municipal and industrial uses are estimated at 32.6 mgd by the year 2010. Table 10 presents the projected demands from 1960 to 2010.

Table 10

Estimated Water Demands for Paris, Texas
1960 - 2010

Year	Water Demand mgd
1960	2.7
1961	5.2
1965	16.0
1970	25.5
1980	28.2
1990	30.3
2010	32.6

The estimated yield of Lakes Crook and Gibbon in 2010 is 7.4 mgd based upon a siltation study made by the Soil Conservation Service in 1956. 8/ The present supply is adequate, therefore, to meet municipal demands through 1961 and the initial demand created by the Campbell plant. In other words, the Campbell plant cannot be put into full production without the development of supplemental water sources to augment the present supply. As a point of interest, it has been learned from the Paris Chamber of Commerce that several firms have declined to locate in the area due to the inadequacy of the present supply to meet their demands. 17/

The anticipated supplemental water needs for Paris are shown in Table 11.

Table 11

Estimated Additional Water Supply Needs for Paris, Texas
1960 - 2010

Year	mgd
1960	Present supply adequate
1961	Present supply adequate
1965	6.9
1970	16.6
1980	19.7
1990	22.2
2010	25.2

Since the present supply will be inadequate so soon, it appears that the development of a new source of supply must be begun now in order to have it in operation by the time it is needed.

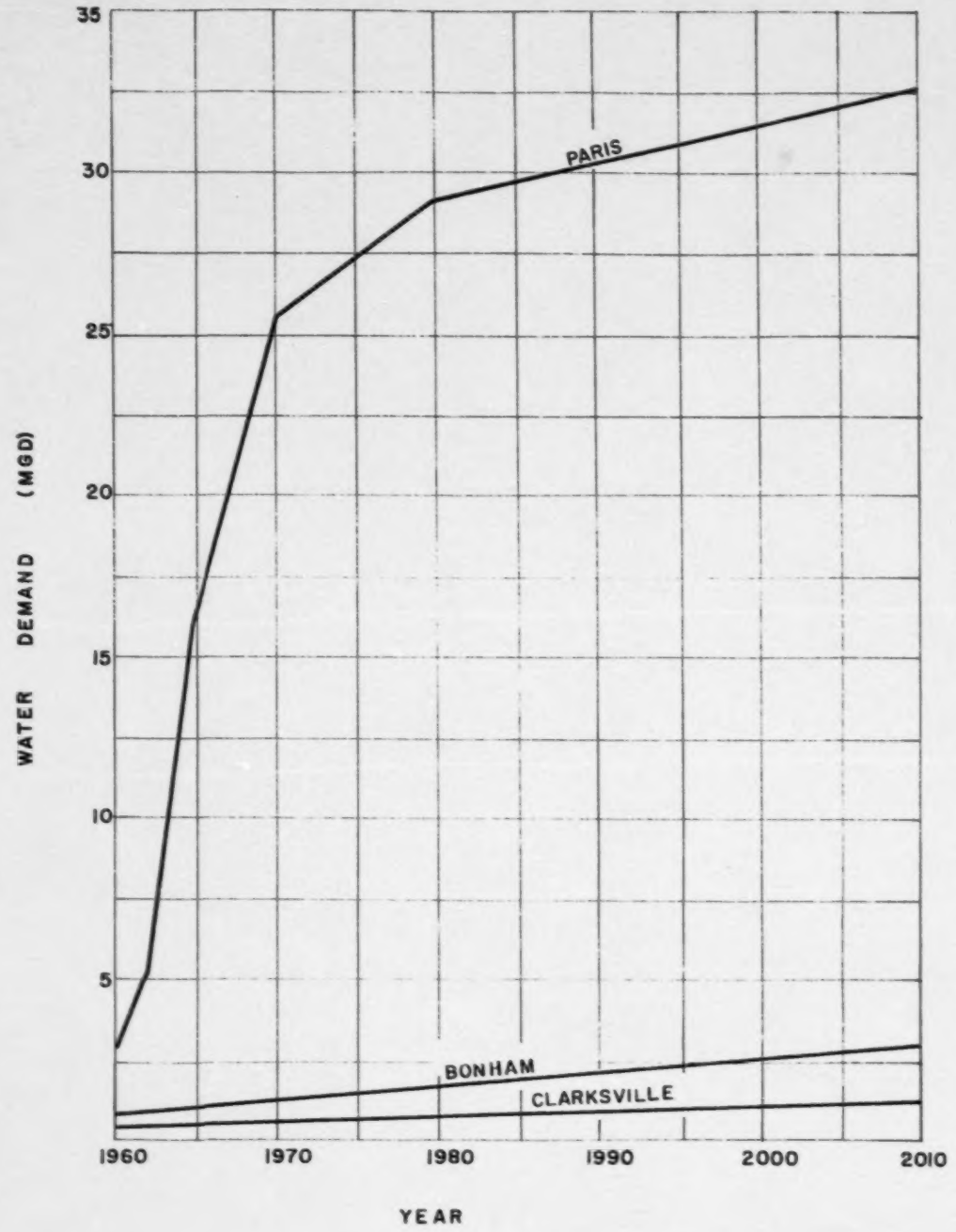
Although the future water needs for Paris are below the 55 mgd yield of the proposed Sanders Creek Project, the city has furnished the Corps of Engineers with a resolution indicating that it desires to purchase the entire output. Therefore, in determining alternative sources for use as a measure of the value of water supply and storage, only those sources capable of supplying 55 mgd were considered. In the case of the Corps of Engineers Sanders Creek Project, ground water studies indicate that this source is inadequate as an alternative. In so far as surface water is concerned, the only alternative to the proposed multipurpose project capable of yielding 55 mgd appears to be a single-purpose project at the same site.

Value of Storage in Sanders Creek Project

Since the alternative site is identical to the proposed Sanders Creek Project, there will be no difference in water quality, treatment required, or transmission costs to the point of use between the alternatives and the Sanders Creek Project. Therefore, the average annual value of storage in the Corps of Engineers proposed Sanders Creek Project, capable of yielding 55 mgd, is $222,000, the cost of constructing a single-purpose project at the same site, based upon amortization of the alternative over 50 years at 4 per cent interest.

Acworth Dam Site

A preliminary survey of possible water supply needs which might be satisfied by a dam and reservoir on Collier Creek indicates that no demand exists for water from this reservoir. It appears that no further study at the Acworth Project is warranted at the present time.



SANDERS, BIG PINE & ACWORTH
RESERVOIRS

ESTIMATED WATER DEMAND

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

HJS

FIGURE 4

WASTE DISPOSAL

The use of large quantities of water for municipal and industrial purposes is possible only if satisfactory disposal can be provided for resulting wastes. The principal source of wastes utilizing water from the Sanders Project is anticipated to be the city of Paris.

Paris discharges its treated wastes into Pine Creek, which could have a sustained flow of 9.5 mgd if the use of Lakes Crook and Gibbons as a source of municipal and industrial water supply is discontinued and all water is obtained from the Sanders Creek Project. If these lakes continue to be used as a source of water supply, it appears that the flow downstream of the reservoirs will be negligible during certain periods of the year, except for the waste discharges. In either case, the flow does not appear to be adequate to assimilate the wastes anticipated from the development of the large scale food processing industry plus other industrial and municipal wastes, if the locations of such industries are such that all wastes discharge into Pine Creek. Some limitation or regulation of the locations of industry may be necessary to prevent adverse conditions of pollution in Pine Creek.

Under average low-flow conditions, it appears that the Red River can assimilate the wastes from Paris. However, under conditions of extreme low flow, there may be insufficient assimilative capacity, and regulation of waste discharges may be necessary to prevent a serious pollution problem.

A detailed study of other waste discharges into the same reach of the Red River and/or analysis of flow data are necessary to more clearly define the problem. The discharges will, however, have no effect on the water quality impounded in the Sanders Creek project.

A more thorough study of the effects of waste discharges on water quality is necessary on both the Sulphur and Red Rivers to provide a more definitive statement as to possible pollution problems. Such a study is beyond the scope of this report, due to time and fund limitations. Consideration of the waste problem will be undertaken in a comprehensive water resources study of southeastern Oklahoma and adjacent areas, to be made by the Public Health Service.

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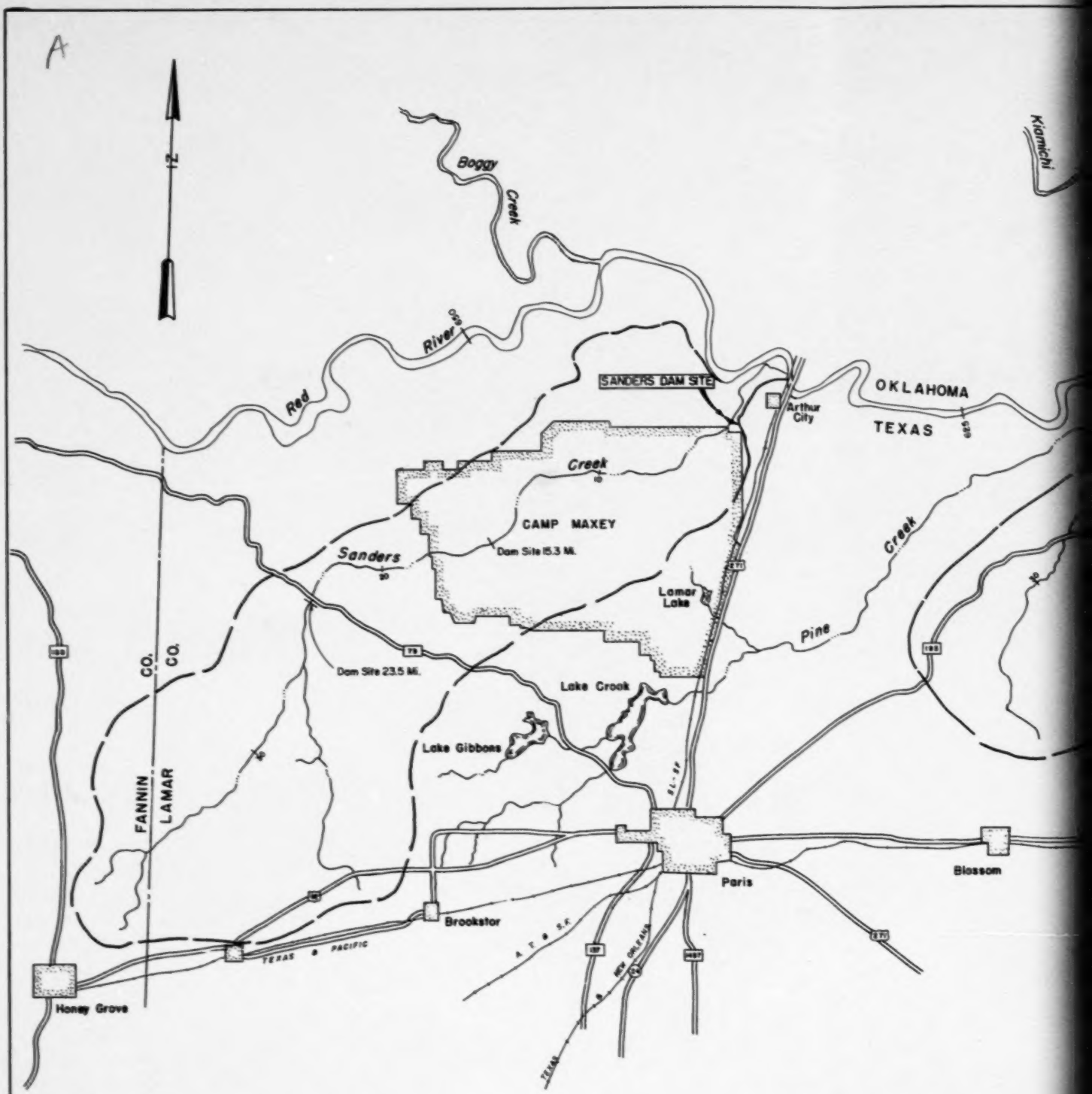
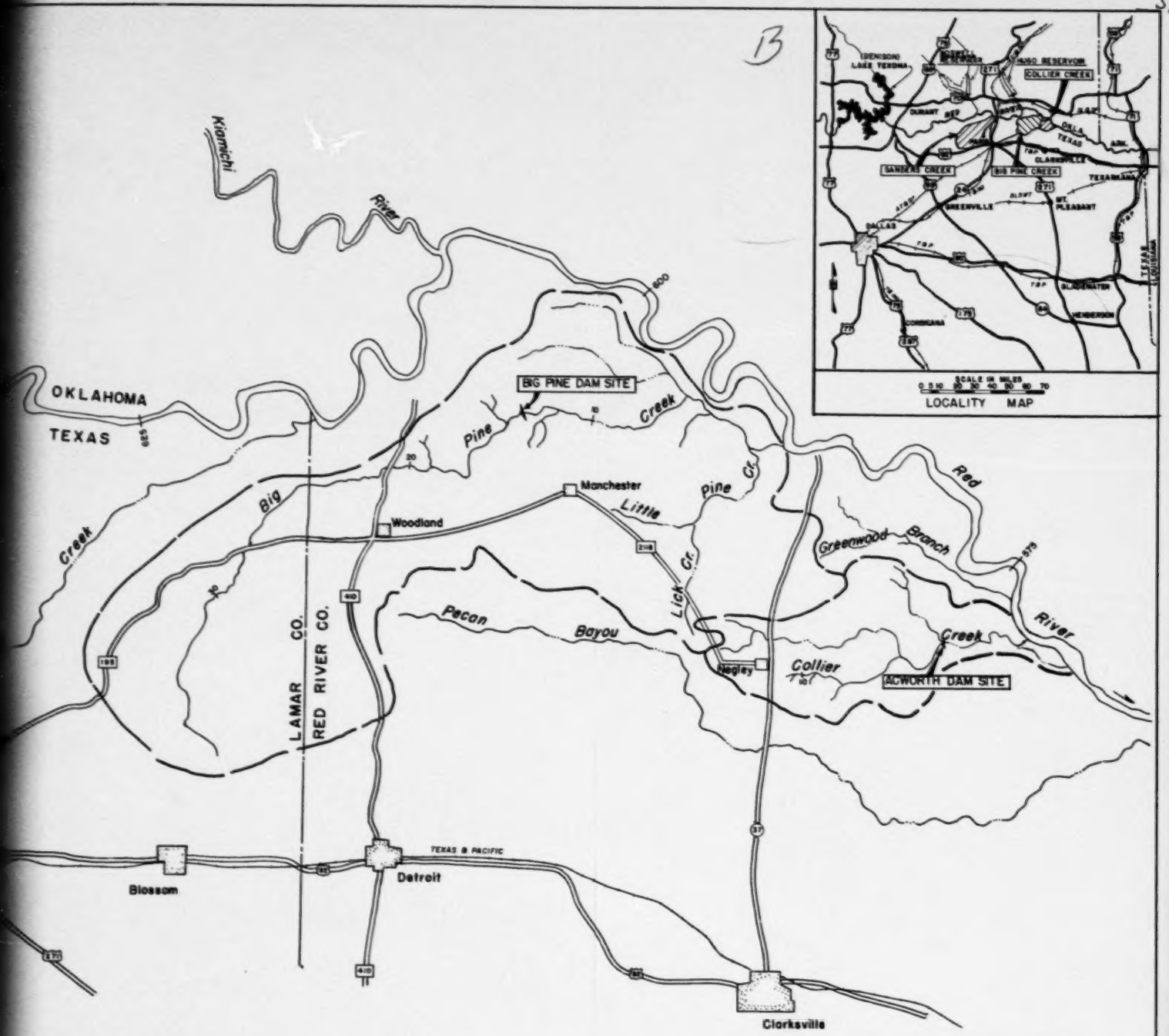

A
Boggy Creek
Red River
SANDERS DAM SITE
Arthur City
OKLAHOMA
TEXAS
Kiamichi
Creek
CAMP MAXEY
Dam Site 15.3 Mi.
Sanders Creek
Lamar Lake
Pine Creek
Dam Site 23.5 Mi.
Lake Crook
Lake Gibbons
FANNIN CO.
LAMAR CO.
Paris
Blossom
Brookston
Honey Grove
TEXAS & PACIFIC
A. T. & S. F.
TEXAS & NEW ORLEANS



COURTESY CORPS OF ENGINEERS U.S.ARMY

SANDERS, BIG PINE & ACWORTH RESERVOIRS
WATERSHED MAP

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE 1